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Pediatric Rapid Response Team: Vital Sign Based System vs. Pediatric Early Warning Score System

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Introduction

- Approximately 8.5-14% of cardiopulmonary arrests in pediatrics occur outside the ICU with associated mortality rates from 50-67%[1]
- Only 10% of pediatric patients who suffer a cardiopulmonary arrest survive intact one year post-event and 35% experience neurological deficits[2]
- Pediatric rapid response teams (PRRT) are effective in preventing codes which decrease mortality in pediatric patients by 18%[1]
- The prior PRRT system was triggered by one abnormal vital sign (VS) parameter that limited nursing staff autonomy and critical thinking skills, resulting in the ineffective use of resources and staff
- Pediatric physiology easily prompts VS changes due to anxiety, fever, or medication delivery, thus resulting in unnecessary PRRT activations
- Pediatric Early Warning Score (PEWS) system is an evidence-based tool shown to identify trends in patient hours preceding a cardiopulmonary event enabling earlier interventions[3,4] and prevention of further deterioration

Objectives

- **Goal:** Using the evidence-based PEWS criteria to improve recognition of deteriorating pediatric patients, allocation of PRRT resources, and pediatric staff satisfaction regarding the PRRT process
- **Goal Assessment:** Compare the number and types of interventions for activated PRRTs, ICU transfers, and staff satisfaction surveys pre- and post-intervention

Methods

- PEWS (Table 2) evaluates 3 domains: behavior, cardiovascular, and respiratory; each domain ranges in point values from 0-3; a flowchart (Figure 1) has specific protocols for each score; normal VS parameters were established by age group
- PEWS replaced the VS based system on 20 Jun 2016; pediatric nursing staff were trained on PEWS prior to this date; pre- and post-intervention data were collected from Oct 2015 - Jun 2016 and Jul 2016 - Dec 2016, respectively
- Data were collected on age, activation criteria, interventions performed, ICU transfers, code blues, potential missed opportunities, patient acuity, patient care days, and number of monthly discharges
- Patient acuity was estimated using nursing workload data from the Workload Management System for Nursing Internet (WMSNi)
- Potential missed opportunities were defined as patients meeting PRRT activation criteria that did not have a PRRT activated
- PEWS was estimated in the pre-intervention group based on chart review
- Pre- and post-intervention surveys were administered to all pediatric ward and ICU staff regarding perceptions and confidence in the PRRT process
- Survey questions were partially derived from Akre, et al[3] and used a Likert scale
- Surveys were analyzed using groups of favorable, neutral, and unfavorable responses, and analyzed by job title (physician, ward staff, ICU staff)
- Surveys were excluded if unable to determine whether the staff employment start date was prior to the initial study period
- Categorical data were analyzed using Fisher's exact and Chi-square statistical methods; p-values <0.05 were considered statistically significant

Table 1: Pediatric Rapid Response Team (PRRT) Demographics

	VS Based System	PEWS
Median [IQR] Patient Age (years)	5 [2, 7.25]	2 [1, 12]
Median [IQR] PEWS*	2 [1.75, 5]	5 [5, 6]
# PRRTs Called	36	22
Rate of PRRTs (per 1,000 patient care days)	20.2	15.5
Pediatric Ward Code Blue Events	1	1
# Potential Missed Opportunities	28	7
Median [IQR] Patient Acuity (WMSNi)	3.5 [3.3, 4.0]	3.5 [3.4, 3.5]
Mean Monthly Patient Care Days	200.3	237.2
Mean Monthly Discharges	111.5	107.5

*VS system PEWS estimated from chart review

Table 2: Pediatric Early Warning Score (PEWS) Criteria

	0	1	2	3
Behavior	-Playing -Alert -Appropriate at baseline	-Sleep -Fussy but consolable	-Irritable/inconsolable	-Lethargic -Confused -Reduced response to pain or stimulation
Cardiovascular	-Pink -Capillary refill 1-2 seconds	-Pale -Capillary refill 3 seconds	-Grey -Capillary refill 4 seconds -Tachycardia of 20 above normal rate	-Grey, cyanotic, or mottled -Capillary refill 5+ seconds -Tachycardia of 30 above normal rate or bradycardia
Respiratory	-Within normal parameters -No retractions	- # 10 above normal parameters -Use of accessory muscles -30+% FiO2 -3+ Liters/minute	- # 20 above normal parameters -40+% FiO2 -8+ Liters/minute -Tracheostomy or ventilator dependent	- # 5 below normal parameters with retractions or grunting -8+ Liters/minute

Figure 1: Pediatric Early Warning Score (PEWS) Flowchart

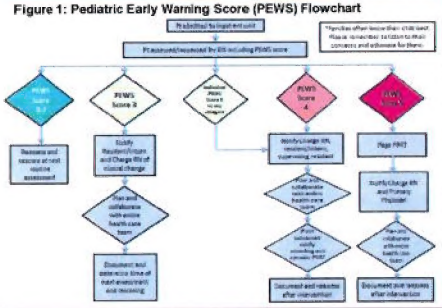


Figure 2: Pediatric RRT Interventions (VS System vs. PEWS)

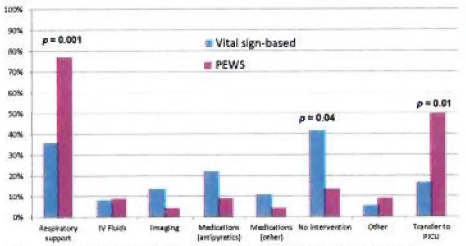


Figure 3: Pediatric Rapid Response Team (PRRT) Monthly Tracking

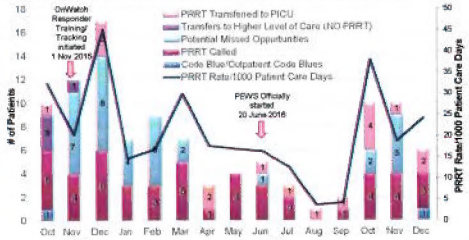
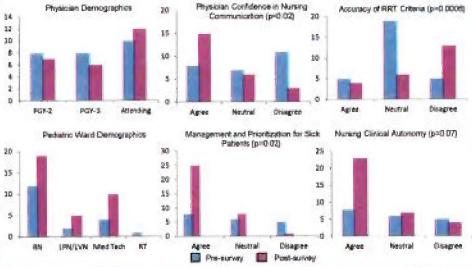


Figure 4: Physician and Pediatric Staff Satisfaction Survey Results



Results

PRRT Data (Table 1, Figure 2, Figure 3):

- 58 PRRTs and 2 code blue events were activated during the study period
- Median age of the patients were younger (2) than in the post-intervention group (5).
- Post-intervention rate decreased from 20.2 to 15.5 RRTs/1000 patient care days
- WMSNi data suggested that patient acuity was unchanged across the study, although Dec 2016 was unavailable, which is typically a higher acuity month
- Median monthly patient-care days increased from 200.33 pre-intervention to 237.17 post-intervention, which confirms a higher daily ward census
- Mean monthly hospital discharges were 111.5 pre- and 107.5 post-intervention
- During the use of the PEWS, there was an increase in clinically significant interventions (p=0.04), respiratory support (p=0.001), and ICU transfers (p=0.01), in addition to fewer potential missed opportunities

Physician and Pediatric Ward Staff Survey Data (Figure 4):

- 67 pre-surveys and 73 post-surveys were collected [26 (50%) pediatric physicians, 29 (64%) ward staff, and 12 (67%) ICU staff pre- and 25 (48%) physicians, 34 (72%) ward staff, and 14 (74%) ICU staff post-];14 pre-surveys were excluded
- Physicians reported that PEWS improved nursing communication (p=0.02) and more accurately identified deteriorating patients (p=0.13)
- Compared to PEWS, physicians found that the VS based system neglected signs and symptoms important to identify deteriorating patients (p=0.0006)
- Pediatric ward staff reported the PEWS improved management and prioritization of ill patients (p=0.02), and emphasized clinical autonomy (p=0.07)

Conclusions

- PEWS implementation has been an efficient and effective means of identifying deteriorating pediatric patients on the pediatric ward
- Following PEWS implementation, there was a decrease in the rate of PRRTs activated, despite no change in clinical acuity and increased ward census
- Use of PEWS has led to more appropriate identification of deteriorating ward patients, as evidenced by the increase in clinically significant PRRT interventions
- Pediatric staff report increased confidence managing deteriorating patients and improved nursing staff clinical autonomy

Future Directions

- Continue improving PEWS system through subsequent PDSA cycles
- Consider use of PEWS for pediatric patients in other areas of the hospital
- Continue education and training on PEWS system for new pediatric staff

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